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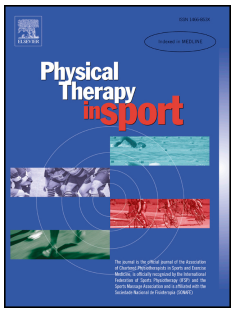

Does kinesiology taping of the ankles affect proprioceptive control in professional football (soccer) players?

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Dear Editor,

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The title of the paper is:

Does kinesiology taping of the ankles affect proprioceptive control in professional football (soccer) players?

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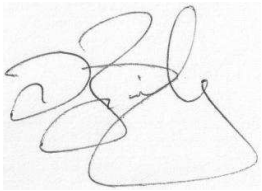
Thank you.



Daniel Bailey

Does kinesiology taping of the ankles affect proprioceptive control in professional football (soccer) players?

Abstract

Objective: To determine whether the bilateral application of kinesiology tape (KT) to professional footballers' ankles can improve their lower limb proprioception.

Design: A single blind randomised crossover study. Participants were randomly assigned to complete a proprioception test in either a taped or not taped condition first. Following a wash out period, participants were then re-tested in the alternate condition.

Setting: A UK Championship League Football Club, mid-season.

Participants: Twenty male professional football players over the age of 18, currently match fit with no injuries.

Outcome measure: Proprioception was assessed by participants undertaking the moving target program on the balance module attached to a Kin-Com 125AP isokinetic dynamometer. A paired sample two tailed t test was used to assess whether there was a significant difference between the participants test scores in the not taped and taped conditions.

Results: The bilateral application of KT to professional footballers' ankles did not bring about a significant change in participants' scores when tested with a fine movement and balance control test. Percentage accuracy score mean difference 4.2 ($p=0.285$).

Conclusion: The results of this study do not support the use of KT when applied to the ankles of healthy footballers as a method of improving proprioception.

1. Introduction

Football has been shown to have the highest incidence of injuries among comparable team sports, with the ankle being the most commonly injured area[1]. The average recovery time for severely injured ankles in professional footballers is 61 days, and up to 28 days for moderate injuries[2]. A large study of 380 athletes demonstrated that following an ankle injury, 73% will suffer a further similar injury, and 59% will continue to have residual symptoms[3]. These findings may be factors in the higher prevalence of ankle osteoarthritis observed in former elite football players, compared to the normal population[4,5]. A retrospective analysis of data collected from 14,776 players in the English Football Association academies between 1998 and 2006, showed there was a mean incidence of one ankle injury per player per year[6]. In view of the findings of these studies, it can be concluded that footballers are a particularly high risk group of athletes for ankle injury. Furthermore, it could be argued that current methods of rehabilitation may be inadequate due to the high percentage of re-injuries, persistent symptoms, and long term complications.

Ankle injuries, such as an inversion strain of the sub-talar joint, commonly result in trauma to the soft and bony tissues, which are associated with pain and changes in the normal function of the joint[7]. Such changes have been shown to include a reduction in proprioceptive capabilities, which some research has suggested is an important risk factor for further injury[7-14]. Three major sensory systems are involved in balance, namely; vision, the vestibular system, and the somatosensory system[15]. The latter is normally considered to be what strictly constitutes proprioception, and consists of mechanoreceptors which generate our joint position sense (JPS), and the sometimes separately termed kinaesthesia; the sensation of movement. These sensations are conveyed by afferent nerves from mechanoreceptors in the ligaments and joint capsules, muscle spindles in the muscle belly, golgi tendon organs in the muscle's tendon, and cutaneous receptors in the skin[11]. Studies investigating factors contributing to JPS have demonstrated that the cutaneous input, particularly skin stretch, has a greater impact on the accuracy of an individual's JPS, than input from the ligaments or joint capsules[16,17]. While this has only been demonstrated in the index finger, elbow and knee, it suggests that an intervention which can facilitate the cutaneous aspect of proprioception may be clinically beneficial.

Kinesiology tape (KT) is used widely in sport for the treatment and prevention of injuries and enhancement of performance[18]. KT demonstrates significantly lower initial stiffness, higher late stiffness, and more consistent maintenance of support than inelastic tape[19]. This means KT allows more movement to occur initially in a joint, but becomes more resistant the more it is stretched. This is ideal for joint applications, as it allows the joint to move through a normal range, but becomes more resistant as the joint moves toward its end range. It is also more resilient to repeated stretching, making it more appropriate for use in sport where repetitive movements take place. While there is

some evidence to demonstrate its efficacy in the enhancement of muscular activity for the purposes of performance gains[20-24], a systematic review and meta-analysis concluded that there was no evidence to support the clinical use of KT for individuals with musculoskeletal conditions[18,25]. However, the meta-analysis only included one trial measuring proprioception, and the systematic review only included self-reported pain, quality of life, and disability outcome measures. One of the proposed mechanisms of action of KT, is the facilitation of neurological activity in the receptors of the skin, thereby enhancing proprioception[26]. If this mechanism can be demonstrated, KT may have a role in the rehabilitation of individuals who have suffered an ankle injury.

Proprioception has been described as more than the cumulative input of sensory information, as an individual's proprioceptive performance also relies on their ability to integrate such information[27] and use it to "effect performance changes during task execution"[28]. For example, the central processing of proprioceptive signals from the foot, has been shown to be critical for effective balance control, an important component in the prevention of ankle injury[29]. A recent systematic review has identified that there is no single measure of proprioception, but of the 32 different tools identified, the most common construct measured was active or passive joint position matching, followed by passive motion detection[28]. However, these methods do not require central processing of sensory input, to effect a simultaneous motor output. Despite previous studies investigating the effects of KT on ankle proprioception, no study has used a weight bearing task which requires movement of the whole body, and the joint to which the tape is applied to control balance[30-34]. It is hypothesised that such a testing method would be likely to demonstrate effects from the application of KT, as continuous changes in skin stretch from joint movement would be affected by the associated stretch of the affixed tape. This study therefore used a bipedal standing balance and fine movement control test, to assess the effect of KT on the proprioception of healthy professional footballers. The null hypothesis being: the bilateral application of KT to professional footballers' ankles will not affect their proprioception when assessed with a fine movement and balance control test.

2. Methods

2.1 Participants

Inclusion criteria: professional full time football players, over 18 years of age from a UK Championship League Football Club.

Exclusion criteria: players who are currently injured or deemed not fit to play by the head of the medical department. Players were not excluded on the basis of previous injuries, as any deficits in physical function resulting from previous injury should have been identified by the regular screening undertaken in the medical department, and resolved through appropriate rehabilitation. Furthermore, due to the prevalence of lower extremity injuries in professional footballers, exclusion on this basis would have made it impossible to recruit sufficient participants from one club.

Participants were randomised to either first take the test with or without the tape applied, they then repeated the test in the alternate condition following a washout period. A computer-generated randomisation was performed. The participants were randomly allocated into blocks of four, within one of the two sequences of testing. The randomisation was performed by the lead researcher who was not involved in the data collection process. The study was approved by the Keele University School of Health and Rehabilitation Ethics Committee in accordance with the Declaration of Helsinki.

2.2 Procedure

On attending the medical department for testing, participants due to undertake the test in the taped condition had original Kinesio-tex Kinesio-tape® applied by the researcher in accordance with the manufacturer's guidelines[26] (see figures 1 and 2). Participants' football socks were pulled up to the knee to ensure the research assistant recording the scores of the test was blinded to whether the participants were in the taped or not taped condition. Once the equipment had been calibrated to the individual participant, they were asked to undertake a one minute familiarisation task on the test equipment. This involved completing a task similar to that of the test procedure. Immediately after the familiarisation task the participants were asked to undertake the balance and fine movement control test, with their score subsequently recorded on a data sheet which was later anonymised to maintain blinding. A scripted set of instructions were used for the entire testing procedure. A minimum one week washout period was ensured before participants repeated the test in the alternate condition. The participants completed the tests after their morning training session and all tests were completed within a three month period of the football season. All participants wore the same standard issue club football socks and training shoes for the tests.

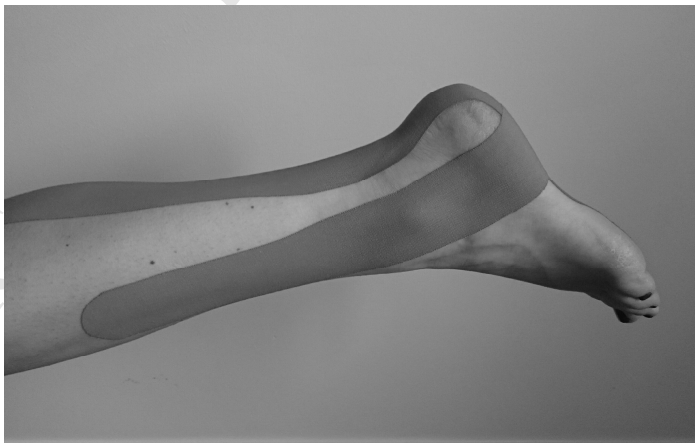


Figure 1. Lateral view of taping to the left leg.

Figure 2. Inferior view of taping to the left leg.

2.3 Balance and fine movement control task

Proprioceptive ability was assessed in this study using a balance and fine movement control task. Force plates measured the accuracy of the participants' ability to control their centre of pressure (COP), via postural sway and small foot and ankle movements. This required integration of proprioceptive sensory feedback in order to constantly modify a motor task: postural sway, which has been shown to be highly dependent on control of the foot and ankle[15,29]. A reduced ability to control postural sway has also been associated with delayed peroneal muscle activity following sudden perturbation, functional ankle instability[34], and an increased risk of ankle injury in soccer players[35].

The balance and fine movement control task undertaken by the participants, was the moving target program from the balance module of a Kin-Com® 125AP isokinetic dynamometer (see figure 3). The balance module consists of two load cell based force plates, which measure load around two axis; anterio-posterior and medio-lateral. The computer software calculates the centre of pressure (COP) based on the measurements from the left and right force plates. The COP is then represented as a cross on the computer screen. By shifting their body weight anteriorly, posteriorly, medially or laterally (postural sway), participants can control the position of their COP and therefore the position of the on-screen cross. Similarly, small movements of the foot and ankle, not normally exceeding 10º when combined with postural sway, into plantarflexion, dorsiflexion, inversion or eversion, will also affect their COP. The moving target program required the participant to control the on-screen cross so that its position corresponded with that of a computer controlled target circle moving in a circular

direction on the screen in front of them (see figure 4). The software calculated the amount of time the cross was within the circle during a one minute period and produced a percentage accuracy score.

Previous research has investigated the test-retest reliability of postural sway assessment via COP as measured by a force plate. Intra-class correlation coefficients of 0.68-0.91 were demonstrated for short and long term (1 and 120 days) reliability[36]. Furthermore, two axis force plates similar to those used in this study, have been shown to perform as reliably in the measurement of postural sway as three axis laboratory grade force platforms, which are capable of measuring vertical as well as antero-posterior and medio-lateral forces[37].

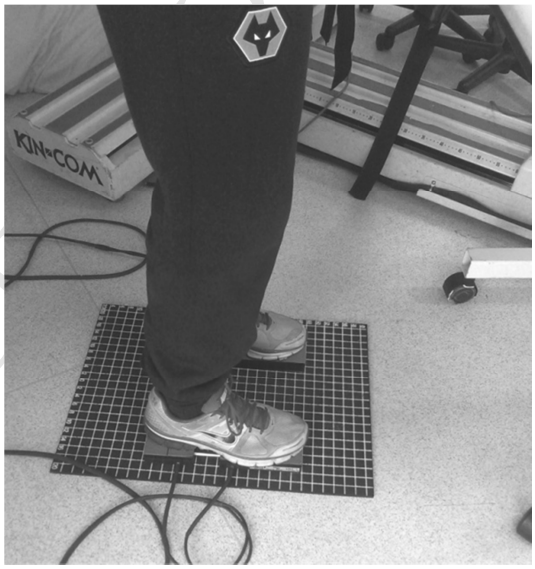


Figure 3. Force plate stance

Figure 4. Target circle and controllable cross

2.4 Data analysis

The statistical package IBM® SPSS® V.21 was used for all statistical analysis. The Shapiro-Wilk test was used to check for normality of distribution in the data, including the participants' height, weight and age. The non-significant result along with assessment of histograms and Q-Q plots of the data demonstrated a normal distribution, therefore the data fulfilled the requirements for parametric testing. A paired samples 2 tailed t test for a comparison of the means with a 5% significance level ($p=<0.05$) was used to compare the participants' test scores in the not taped and taped conditions. A power calculation was performed demonstrating 83% power to detect a moderate to large effect size of 0.65 and 95% power to detect a large effect size of 0.8 or more (standardised mean response according to Cohen's effect size classification[38]).

3. Results

A convenience sample of 20 players agreed to take part, all of whom completed both tests. The mean percentage test scores for participants in the not taped and taped conditions are presented in Table 1. No significant difference was observed between the not taped and taped scores with a mean difference in percentage accuracy score of 4.2 ($p=0.285$). The null hypothesis that the bilateral application of KT to professional footballers' ankles will not affect their proprioception when assessed with a fine movement and balance control test, was retained. The effect size was calculated to be 0.25 and therefore small ($p=0.285$)[39,40]. The participants' mean data was as follows (±SD): age 25.2 years (±5.79); height 184cm (±4.99); and weight 82.1kg (±5.77).

Table 1. Proprioception test accuracy scores

	mean %, ±SD, (95% CI)
Not Taped	52.0 ±16.9 (44.1, 59.9)
Taped	56.3 ±16.3 (48.6, 63.9)
Difference	4.2 ±17.2 (-3.8, 12.3)

4. Discussion

The purpose of this study was to establish whether it is possible to improve professional footballers' proprioception via the bilateral application of KT to their ankles. The study assessed participants' proprioception using a standing fine movement and balance control test, and found that there was no significant difference in participants' percentage accuracy scores with or without KT applied to their ankles. This assessment method was chosen as it required the participants to use all the sensory components of balance and lower limb fine movement, namely: vision, the vestibular apparatus, joint position sense, and kinesthesia. It also required the information to be processed in order to accurately and constantly control a motor activity. Rehabilitation approaches which require a combination of these sensory inputs have been shown to be beneficial in improving proprioception[8-10]. It is reasonable to assume therefore, that if proprioception plays a key role in such activities and KT is able to affect proprioception, it should have been measurable with the fine movement and balance control test used in this experiment. Previous similar studies have measured JPS via movement threshold detection or position matching, but only unilaterally or in a non weight bearing position[30,33]. When using JPS as an outcome measure, proprioceptive information is most likely to be communicated via the muscle spindles measuring muscle length, and the golgi tendon organs measuring force[17]. For assessing the efficacy of KT, it was felt that kinesthesia was a more important modality contributing to proprioception, as it relies more on cutaneous stimulation from skin stretch. Although a balance challenge has been used in a previous study of rugby players, participants were required to prevent the movement of an unstable surface, thereby minimising the amount of joint movement and potential for skin stretch[32].

4.1 Clinical Implications

The clinical implications of the results of this study are that the use of KT to facilitate healthy footballers' proprioception is not supported. The test used in this study was representative of

proprioceptive function in weight bearing activity, furthermore, similar studies using different methods of assessing proprioception have also failed to find a significant effect following the application of KT[30,31,33]. This study and others concerning proprioception have only investigated the immediate effects of KT application. It is not known whether prolonged application of the tape increases its effects.

4.2 Study Limitations and Areas for Future Research

As there is no gold standard test for proprioceptive ability, it is possible that the method chosen in this study does not measure the constructs of proprioception most relevant to ankle injury prevention in footballers. It is also difficult to compare results between studies using different methods of assessing proprioception. Arguably, a method involving sudden ankle perturbation, with subsequent measurement of muscle activation delay or time taken to normalise the COP, would more accurately mimic the circumstances involved in an ankle strain. Such methods however, may reduce participant recruitment due to the perceived risk of injury, particularly among professional sportspeople. Future studies may benefit from using a more dynamic measure of proprioception involving larger ranges of movement at the ankle, and consequently greater skin stretch. For example, time taken to normalise COP movement following a lunge or hop on to a force plate. Employing multiple methods of proprioception measurement may also provide a more robust assessment of its function.

The sample size for this study was small (n=20), although adequately powered. This study only included participants who were free from injury, as such no conclusions can be drawn on the effect of KT when applied to injured footballers. Further research should seek to use a larger sample of players and stratify their results according to whether they have a history of injury, are currently injured, or are injury free. Normative data for the test used would also help to quantify any change observed. The use of a crossover methodology would be appropriate as it controlled well for an order effect observed in some of the participants of this study, a longer familiarisation procedure may also help to reduce the order effect.

5. Conclusion

The results of this study indicate that the application of KT to healthy professional footballers' ankles does not improve their proprioception. The use of KT on healthy individuals for the purpose of reducing injury risk is not supported by this study. The results of this study add to the existing evidence which shows that KT has no significant effects on proprioception. Further high quality research investigating the physiological effects of KT is needed, as previous systematic reviews and meta-analysis have concluded that the majority of existing studies demonstrate no beneficial effects or poor methodological design.

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Highlights

- Randomised crossover study investigating the effects of kinesiology tape.
- Proprioception was assessed in professional soccer players with and without tape.
- A standing fine movement and balance control test evaluated proprioception.
- There was no improvement in players' test scores when wearing kinesiology tape.

Ethical Statement

This study was approved by the Keele University School of Health and Rehabilitation Ethics Committee in accordance with the Declaration of Helsinki.

All participants were provided with an information sheet detailing the requirements of the study before agreeing to participate. After reading the information sheet, those participants wishing to take part signed a consent form.